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Growth Adaptation of Two Indonesian Black Rice Origin NTT Cultivating In Organic Paddy Field, Malang-East Java

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ABSTRACT

This research is aimed to study the growth adaptation of two Indonesian black rice NTT in origin which is cultivating in organic paddy field in Malang - East Java and its problems during a planting period. A descriptive exploratory research was conducted in two organic rice fields in Kepanjen District, Malang Regency. Those fields were grown with two different varieties of black rice NTT in origin namely, Laka and Woja Laka. Each rice field was recorded periodically. The growth was including the plant height, biomass, density of tiller, panicle and spikes, dry seed weight and the problem correlated to pest and climate's limitation. The results showed that Woja Laka and Laka black rice varieties slightly gave a different growth pattern. Laka variety was taller than Woja Laka, i.e. the Laka could reach 200 cm of height, while the Woja Laka was maximum 150 cm of height. However, the density of Woja Laka tiller and its panicle were almost double than the Laka ones. The dry seed weight and spikes number of Woja Laka were much higher than in Laka ones. In terms of organic farming system, Laka rice seemed to be more sensitive towards the strong wind conditions and bird or rat attacks rather than Woja Laka. Both pests attacked on both black rice along growing period, but rat preferred to attack vegetative part, otherwise bird strongly disturbed during generative period.

Keywords: black rice, growth, Laka, Woja Laka, organic paddy field

INTRODUCTION

Black rice is the most popular staple food in Europe even more than Southeast Asia consumption (Simmons & Williams, 1997). Based on historical record, black rice is only for the kings of China and Indonesia (forbidden rice). This is because black rice has a double function, namely as a source of staple food with good taste, fluffier and fragrance, as well as an efficacious medicine to cure various illnesses (Kristamtini, 2009).

Previous studies showed that black rice was an alternative healthy food for diseases treatment as it contains antioxidants agent, such as anthocyanin (Chutipaijit et al., 2011). Anthocyanin extract of black rice was reported to be able to inhibit the growth of liver cancer cells (Chen et al., 2006), reduce the blood plasma levels of cholesterol, triglycerides, LDL (low-density lipoprotein) and raise HDL (high-density lipoprotein), and potent for cardiovascular disease therapies (Kim et al., 2006; Xia et al., 2006; Wang et al., 2007; Zawistowski et al., 2009; Salqado et al., 2010).

Because of long growing period and sensitivity to natural enemies, black rice cultivation in Indonesia is very rarely. However, the high demand of black rice, especially as the healthy food source, encouraging some farmers in Kepanjen District, Malang Regency for developing its cultivation organically. The rice variety cultivated in Kepanjen is Laka and Woja Laka which is Manggarai in origin, Nusa Tenggara Timur (NTT) Indonesia. This paper reported their growth adaptation and its problems during a planting period.

MATERIALS AND METHODS

The growth observation was conducted from November 2011 until March 2012 in two organic rice fields in Kepanjen District, Malang Regency – Indonesia. Two different rice fields were planted with different varieties, Laka and Woja

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Laka variety. The growth of each field was recorded periodically during a planting period at interval time 19-29 days after planting (dap), 41-45 dap, 62-66 dap, 77-81 dap, 90-94 dap and 104-106 dap, including plant height, density of tiller, panicle and spikes and its problem related to pest and climate disturbance. In the harvest season (104-106 dap), we also observed vegetative biomass and dry seed weight.

RESULT AND DISCUSSION

Woja Laka and Laka black rice varieties slightly differed on their growth pattern. Maximum height of Woja Laka variety was 105-150 cm. This was lower than the Laka, 157-200 cm (Fig. 1). Since the hill was high, Laka had a higher risk of collapse due to gale. On the other hand, Woja Laka was able to maximized tillering process of producing lot of tillers. It reached 36 tillers per hill whereas Laka gave 18 tillers per hill.

The number of tillers per hill determined the panicle number which could be produced by two black rice varieties. Naturally, each tiller can produce one panicle. As Woja Laka had a lot of tiller number per hill, it produced higher number of panicle than Laka. Interestingly, Laka tiller branch was able to provide two sub-tillers, and both tillers could produce one panicle. The panicle appeared when reached age 70-80 dat (Fig 1), and it indicated a phase of transition from vegetative to generative. During generative phase, black rice allocated their nutrition for developing reproductive organ such us panicle and spike forming and grain filling as well. This caused vegetative organ grew slower even stopped.

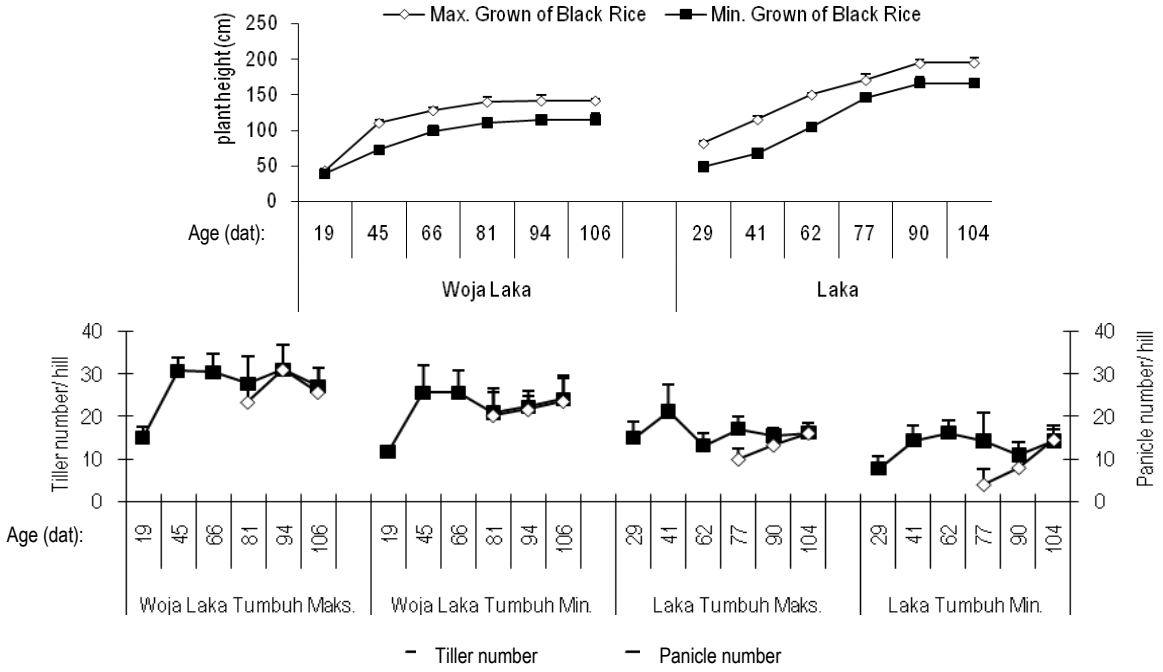

Figure 1. The Growth process of two black rice varieties during a transplanting period in organic paddy field

In black rice population, it was also found some clumps had lower performance than others. Some Woja Laka clumps only reached at 105 cm of height and Laka reached at 157 cm. In that population, the number of tiller, panicle and spike become lower than others as well as dry seed weight and vegetative biomass. This is caused by the variability of the germinated seeds and different environmental conditions (water in paddy fields, soil and wild vegetation). Irrigation, fertilizing and weeding uneven can be a factor of variability of environmental conditions in an area of paddy fields.

Based on the results of descriptive statistical analysis, Woja Laka yielded total number of spikes and dry seed weight per hill was greater than Laka. However, in the number of spikes and dry seed weight per panicle, Laka yielded nearly three times than that in Woja Laka (Fig 2). Furthermore, the Laka cultivation system was using a spacing of 22 cm x 22 cm yielded 206612 clumps per hectare and the result of dry seed weight was greater than Woja Laka (Table 5.1). Therefore, Laka black rice has a higher potency and prospects for further development in organic rice field. In addition, vegetative biomass of Laka

has three times greater than Woja Laka, and it is potential as carbon-sink in the agricultural industry (Table 5.1). Nevertheless, the fact showed that rice yields in both black rice varieties were very low for November 2011-March 2011 period. In the transplanting period, dry seed weight harvested in Woja Laka field only resulted for 1 ton.ha-1. It was lower than normal production in the origin region (Manggarai-NTT), which is 3-4 ton.ha-1 (personal communication with farmers in Manggarai). The low production of Woja Laka was caused by gale at the age of 60 DAT that caused clumps of rice to fall so that the flag leaf became brownish yellow and damaged. The damage of flag leaves was compounded by flooded in paddy field. Flag leaf is photosynthetic organs that had important role in grain filling. High CO2 assimilation in flag leaf of rice plants increased spikelet biomass [3].

Table 5.1. Black rice produktivity per ha in organic paddy field

Black rice	Spacing	Clumps number (ha)	Dry seed weight (ton.ha^{-1})	Vegetative biomass (ton.ha^{-1})
Woja Laka	25 cm x 32 cm	125.000		
Max. growing			5.96	7.39
Min. growing			4.79	5.72
Average			5.37	6.56
Laka	22 cm x 22 cm	206.612		
Max. growing			7.83	19.90
Min. growing			7.06	15.66
Average			7.44	17.78

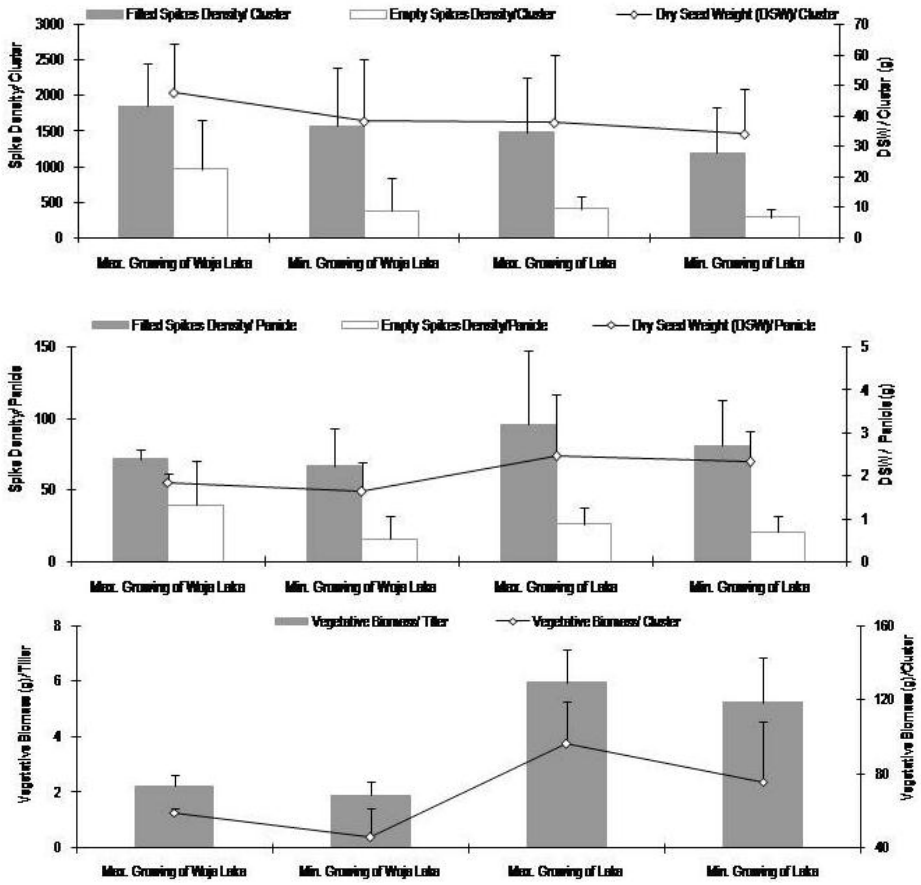

Figure 2. Spikes number, dry seed weight and vegetative biomass of black rice in organic paddy field

In contrast to Woja Laka, the low production of Laka was caused by bird attacks when seed ripening phase. The preference of visiting birds at Laka field was higher than other rice varieties that grew around it. It was also a problem in the original region, Manggarai-NTT. In addition, black rice has a distinctive aroma and striking performance as well (higher, fresh green color of

leaf and horizontal flag leaf) so that the panicle was easily accessed and preferred by birds. During the growing period, Laka leaves became yellowish due to the gale but it was overcome by fertilization with micro NASA, siapton, harmonic, nordox.

CONCLUSION

Woja Laka and Laka black rice varieties differed slightly at the growth pattern. Laka variety was taller than Woja Laka, the first reached at 157-200 cm while the second reached at 105-150 cm. However, the density of Woja Laka tiller and its panicle were almost double than Laka ones. Therefore, the dry seed weight and spikes number of Woja Laka were higher than Laka. In terms of organic farming system, Laka rice seemed to be more sensitive towards the strong wind and bird or rat attacks rather than Woja Laka, red and white varieties. Both pests attacked on both black rice varieties along eith the growing period. However, rat preferred to attack vegetative part whereas bird strongly disturbed during generative period.

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